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## On The Preferences of CoCo Bond Buyers and Sellers: A Logistic Regression Analysis

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**ON THE PREFERENCES OF CoCo BOND BUYERS AND SELLERS:  
A LOGISTIC REGRESSION ANALYSIS**

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**Abstract**

This paper estimates the preference scores of CoCo bond buyers and sellers by running logistic regressions taking into account both bond and issuing bank's characteristics; it also provides evidence on the role of country-specific CoCo bond market concentration. Buyers are defined as having a preference for CoCo bonds if their return-to-risk is higher than the corresponding 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> annual percentile values; the preferences of buyers and sellers are assumed to be mutually exclusive. Differences in the degree of risk aversion of buyers and sellers and in the determinants of their preferences are found across percentiles. Further, coupon payment, conversion mechanism, credit rating and P/B ratio appear to be the strongest global determinants of CoCo bond trading between buyers and sellers, these being very responsive to CoCo bond and issuing bank's characteristics in most European countries, Brazil, Mexico and China (especially in the UK and China).

**JEL Classification:** C25, C39, F39, G11, G21, G24, G28

**Keywords:** CoCo bonds, buyers and sellers, preference scores, logistic regressions

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## 1. Introduction

A contingent convertible (CoCo) bond is a fixed-income security that provides coupon payments to investors until it is converted into equity or suffers a write-down of its face value when the bank's capital level falls below a predetermined lower trigger threshold (De Spiegeleer et al., 2014). CoCo bonds have recently become one of the most commonly used financial instruments for satisfying the more stringent financial regulations imposed by the Bank of International Settlements (BIS) and for protecting banks from insolvency. Consequently, CoCo bond issuance has been steadily increasing, with banks issuing \$450 billion in CoCo bonds globally from January 2009 to September 2015. In addition, the European Central Bank's October 2014 asset quality review (AQR) reported that CoCo bonds accounted for 32 billion Euros of the total of 92 billion Euros in new security issues from July 2013 to August 2014 (Avdjiev et al., 2015).

CoCo bonds add flexibility to the capital structure of banks. Since they are typically treated as debt, they allow banks to take advantage of the benefits of debt financing. Then, when capital falls below the lower trigger threshold during a crisis period, banks can quickly, easily and effectively convert these bonds into equity or write down their principles (Raviv, 2004; Flannery, 2005, 2009; Squam Lake Working Group, 2009; McDonald, 2013, Pennacchi et al., 2014; Avdjiev et al., 2015); thus, CoCo bonds act as automatic bankruptcy protection devices. Regulators have advocated the use of CoCo bonds because they absorb losses without using taxpayers' money (De Spiegeleer et al., 2014). In addition, they constitute banks' Tier 2 capital and add to their Tier 1 capital for meeting the Basel III requirements. For all of these reasons, banks are increasingly issuing CoCo bonds.

However, their high coupon rate is a disadvantage for the issuing firm; also, the loss-absorbing capacity of CoCo bonds is insufficient (Admati et al., 2013; Avdjiev et al., 2015), they suffer from pricing complexities, a high correlation with systematic economic events (Avdjiev et al., 2015) and potential shareholder dilution. Therefore, it is important to understand how equity markets react to the issuance of CoCo bonds and the role played by their characteristics and those of the issuing banks.

To date there have only been a few market analyses based on CoCo bond issuance, most of them being event studies focusing on general equity investors. This paper examines instead the preferences of CoCo bond investors (buyers) and issuers (sellers) between May 11, 2009 and March 19, 2018. These are measured by the ratio of the CoCo bond yield-to-maturity (YTM) to the credit default swap (CDS) spread, which represent the return and risk of CoCo bonds, respectively. In particular, we obtain preference scores by estimating

logistic regressions and define buyers as having a preference for CoCo bonds if their return-to-risk is higher than the corresponding 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> annual percentile values; further, the preferences of buyers and sellers are assumed to be mutually exclusive. In brief, we find that the risk profile and the determinants of both categories of investors vary across percentiles. More specifically, buyers and sellers appear to be risk-averse and risk loving, respectively, in the lower percentile (25<sup>th</sup>): buyers are particularly interested in the soundness of the issuing bank whereas sellers prefer to issue CoCo bonds when they expect a less promising financial outlook satisfying the Basel III regulations. In the middle (50<sup>th</sup>) percentile, both buyers and sellers are very sensitive not only to the issuing bank's financial outlook or conditions but also to the CoCo bond's properties, especially the coupon rate and the equity conversion mechanism. Buyers have a preference for high coupon payments and principal write-downs (which are less restrictive than mechanical equity conversion). On the other hand, sellers prefer low coupon payments to lessen their burden and incorporate mechanical equity conversion when issuing CoCo bonds. Finally, buyers and sellers in the upper percentile (75<sup>th</sup>) are risk-loving and risk-averse, respectively, in contrast to the lower percentile (25<sup>th</sup>) ones; they behave similarly to those in the middle percentile (50<sup>th</sup>) but are also interested in the total CoCo bond amount issued. These buyers prefer banks to issue fewer CoCo bonds to avoid diluting their ownership as shareholders once they are converted into equity. By contrast, sellers prefer to issue more CoCo bonds to have more equity protection against bankruptcy and at the same time comply with the Basel III regulations. We also analyse the role of country-specific CoCo bond market concentration and find that in some countries (the UK and China in particular) buyers and sellers are very responsive to CoCo bond and issuing bank's characteristics.

The layout of the paper is the following: Section 2 reviews the relevant literature; Section 3 develops our hypotheses; Section 4 outlines the methodology; Section 5 describes the data and presents the empirical findings; Section 6 offers some concluding remarks.

## **2. Literature Review**

The extant literature on CoCo bonds is limited, but rapidly expanding. It includes four main strands analyzing CoCo bond developments, properties, design and effects on firms and investors. The first discusses previous versions that highly resemble CoCo bonds. Flannery (2005) proposed a reverse convertible debenture (RCD) that automatically converts into common equity when the market capital ratio falls below a certain threshold, which is determined by the current share price. His work provides critical insights into market triggers

as a mandatory conversion method, using stock prices as a tool for conversion from bond to equity. Flannery (2009) proposed a contingent capital certificate that also uses the market trigger to convert debt into equity.

Raviv (2004) introduced a debt-for-equity swap (DES) contract that pays its holder a fixed payment upon maturity unless the bank's asset falls below a certain pre-determined conversion threshold; otherwise, it converts into common equity. Squam Lake Working Group (2009) suggested a regulatory hybrid security type that remains long-term debt during normal periods and converts into equity when both financial markets and the issuing bank suffer financial distress. Glasserman and Nouri (2012) proposed a contingent capital type with a capital-ratio trigger with partial and ongoing conversion. The capital ratio is based on accounting or book values designed to approximate regulatory capital requirements. The partial and ongoing conversion process enables firms to convert just enough debt into equity to meet the regulatory capital requirements each time the capital ratio falls below the minimum threshold. Finally, Pennacchi et al. (2014) suggested the call option-enhanced reverse convertible (COERC) approach, which resembles a CoCo bond except that shareholders have the option to buy back converted shares from COERC investors at the bonds' par values.

Subsequently, Albul et al. (2013) presented the formal model for CoCo bonds, which started the discussion about their properties. They maintained that CoCo bonds provide most tax benefits as a straight debt, while offering the same protection as equity. This protection increases as the bond's conversion trigger level increases. The Squam Lake Group (Baily et al. 2013) stressed that financial authorities should encourage banks to issue CoCo bonds. In the Bank for International Settlements' (BIS) Quarterly Review, Avdjiev et al. (2013) provided an official explanation of CoCo bonds. They emphasized the importance of the trigger level (mechanical or discretionary) and the loss-absorbing mechanism (conversion to equity or principal write down).

As for research on the design of CoCo bonds, Pennacchi (2010) argued that early conversion during financial distress minimizes the default risk at a lower cost. Himmelberg and Tsyplakov (2012) found that the principal write-down conversion method generates incentives for banks to have high leverage, increasing the cost of financial distress and the cost of capital compared to the equity conversion method. Koziol and Lawrenz (2012) suggested using other devices together with CoCo bonds to control risk-shifting incentives to prevent manipulations of the bonds' risk control technologies and/or contracts. Calomiris and Herring (2013) argued instead that banks should hold significant quantities of CoCo bonds

and use market value triggers with 90-day moving average equity market values. Davis et al. (2014) tested hypothetical CoCo bond data under three different trigger regime scenarios: a fixed-trigger regime, a regulator regime and a prediction-market regime. They concluded that CoCo bonds have fewer conversion errors and are less subject to manipulation under fixed-trigger and prediction-market regimes than under regulator regimes. McDonald (2013) suggested that CoCo bonds should use a dual trigger incorporating the firm's stock price and the financial institution's index as the determinants for its threshold. This approach considers simultaneously both micro and macro financial conditions. As another enhancement, Corcuera et al. (2014) proposed a coupon cancellable contingent capital (Coca CoCo) bond, which cancels its coupon when a pre-defined barrier higher than the conversion barrier is broken through. This discourages speculative short-selling activities and significantly reduces the death spiral effect. Hilscher and Raviv (2014) argued that there is a conversion point at which shareholders become indifferent towards risk-taking.

Yang and Zhao (2014) introduced contingent capital, a contingent convertible security (CCS) that repeatedly converts between debt and equity depending on the firm's financial situation: that is, if the firm falls into (recovers from) recession, it converts from debt (equity) to equity (debt). Yang and Zhao (2015) enhanced this CCS by incorporating an asset jump risk. This new type of CCS dynamically adjusts the firm's capital structure without incurring adjustment costs and does not suffer from debt overhang or risk-shifting incentive problems. Sundaresan and Wang (2015) proved that using market triggers is inappropriate because such triggers involve price uncertainty, market manipulation, inefficient capital allocation and frequent conversion errors with no unique equilibrium. Thus, regulators reacting to market prices may not gain the financial information they need, since their interventions themselves may affect firms' security prices (Birchler and Facchinetti, 2007; Bond et al., 2010; Davis et al., 2011).

Chen et al. (2013) investigated the effects of CoCo bonds. They argued that they benefit the issuing firm if the conversion trigger is not set too low. However, when the CoCo bond-issuing firm takes excessive risk, causing a debt-induced collapse, CoCo bonds can become junior straight debt and the equity value may suddenly drop. Avdjiev et al. (2015) claimed that the contract design of a CoCo bond and the characteristics of the issuing firm are important determinants of its effects. However, in their opinion the beneficial effects of such bonds on loss absorbency and risk-taking incentives are rather weak. On the other hand, Gründl and Niedrig (2015) highlighted the benefits of CoCo bonds, arguing that they are effective in reducing risk-shifting towards taxpayers and enhancing banks' stability. They

added that the current Solvency II standard formula for market risk, which relies on rudimentary risk weights, needs to improve because it fails to estimate the full risk of CoCo bonds. Song and Yang (2016) found that the risk-taking incentives and agency cost of debt increase if shareholders are allowed to choose their optimal CoCo bond conversion barriers by themselves. They also stressed that the risk-taking incentives and agency cost of debt decrease if CoCo bonds have an exogenously imposed conversion barrier.

Numerous studies have analyzed the effects of convertible bonds, straight bonds etc. on financial markets. However, to the best of our knowledge, there are only four previous studies on market reactions to CoCo bond issuances. Avdjiev et al. (2015) and Vallee (2016) found that the reaction of credit default swap (CDS) spreads is significantly negative, whilst that of equity markets is not significant; however, they did not investigate the CoCo bond issue announcement periods. In a subsequent study, Ammann et al. (2017) found significant reductions in CDS spreads in response to CoCo bonds' post-issue announcements and a positive reaction of the equity market. By contrast, Liao et al. (2017) reported a negative reaction, but also detected differences across countries.

### 3. Hypothesis Development

The studies above show that the design of CoCo bonds and the financial situation of the issuing bank determine their effects on investors. We focus on the coupon, maturity, issue size, trigger level, credit rating and conversion method as CoCo bond characteristics.

According to the BIS Quarterly Review by Avdjiev et al. (2013), approximately 64% of CoCo bonds have tax-deductible coupons, while around 20% do not. The tax treatment of the remaining 16% of CoCos is currently under review. Therefore, although high coupon rates are not beneficial to issuers, this negative effect is somewhat mitigated by the favorable tax treatment. On the other hand, insurers clearly benefit from buying CoCo bonds owing to the high coupon rates compensating for the high issuing bank's risk (Gründl and Niedrig, 2015), which has proven to be very attractive in the current low-yield environment (Jaworski et al., 2017). Accordingly, our first hypothesis is the following:

*H1: A CoCo bond's coupon rate is positively (negatively) related to its buyer's (seller's) preferences.*

In the Basel III framework, all Additional Tier 1 instruments must be perpetual. Therefore, approximately one third of CoCo bonds issued have no maturity date. The rest of

the existing CoCo bonds with finite maturity dates are only eligible to obtain Tier 2 capital status under Basel III. Most of them have an original maturity of approximately 10 years (Avdjiev et al., 2013). With a longer or perpetual maturity, CoCo bond investors are likely to enjoy (generally higher) coupon payments than for other debt instruments over a long period, while the opposite holds for CoCo bond issuers. Thus, we formulate our second hypothesis as:

*H2: A CoCo bond's maturity is positively (negatively) related to its buyer's (seller's) preferences.*

CoCo issuance patterns are largely driven by the way Basel III is applied, or supplemented, by national regulators and the tax treatment in different jurisdictions. Banks are motivated to issue CoCo bonds by their need to satisfy the loss-absorbing capital requirements, especially in the UK. Approximately 64% of CoCo bonds have tax-deductible coupons and the rest are either not so or are still under review depending on different countries' jurisdictions (Avdjiev et al., 2013). Asset managers, hedge funds and other banks usually purchase a significant amount of CoCo bonds. Investors from the UK, Europe, and the US are among the largest holders (Avdjiev et al., 2015). A large CoCo bond issue leads to sizeable equity conversions possibly exceeding what would be required to eliminate all risk shifting incentives; instead, it can cause an excessive dilution effect among the existing shareholders (Martynova and Perotti, 2014). This leads to our third hypothesis, namely:

*H3: A CoCo bond's issued amount is negatively (positively) related to its buyer's (seller's) preferences.*

From the CoCo bond issuer's perspective, the trigger level selection is largely determined by the trade-off between regulatory capital eligibility and cost of issuance. CoCo bonds with low triggers have lower loss-absorbing capacity. They tend to be less expensive to issue and are usually used to boost Tier 2 capital in a cost efficient manner while not being eligible to qualify as Additional Tier 1 capital which is relatively more expensive to raise. Over time, however, there has been increasing financial regulatory pressure for banks to boost their Tier 1 capital which requires trigger levels ( $= \frac{\text{Common Equity Tier 1 Capital}}{\text{Risk Weighted Assets}} \geq 5.125\%$ ) higher than those for Tier 2 capital (Avdjiev et al., 2013).



On the other hand, investors may perceive the trigger level of CoCo bonds as too low to spark a conversion, which may be seen as simply more leverage. Therefore, as the CoCo bond's trigger level increases and the likelihood of an early conversion rises, the issuing banks will experience an increase in bankruptcy protection (Ammann et al., 2017), despite the increase in the cost of issuance (Avdjiev et al., 2013), owing to the ongoing regulatory pressure. However, CoCo bond investors are assumed to be primarily fixed-income security investors who are less equipped to manage large losses than equity holders and may want to avoid equity conversions (Avdjiev et al., 2015). Otherwise, they can be forced to internalize the negative consequences of the poor performance of companies which induces CoCo bonds to convert (Ammann et al., 2017). Hence, our fourth hypothesis is the following:

*H4: A CoCo bond's trigger level is negatively (positively) related to its buyer's (seller's) preferences.*

The current equity-capital eligibility regulations do not distinguish between CoCo bonds with different loss absorption mechanisms, i.e. mechanical equity conversion and principal write-down. CoCo bonds with mechanical equity conversion have dominated over the principal write-down ones but the demand for the latter has been increasing over time for two possible reasons. First, fixed-income investors have mandates which often restrict them from holding CoCo bonds with mechanical equity conversions, while CoCo bonds using principal write-down mechanisms do not fall into this category. Second, CoCo bonds with the principal write-down feature involve less uncertainty about the payoff after the trigger level is broken through, which may facilitate their pricing and risk management (Avdjiev et al., 2015). On the other hand, CoCo bond issuers may prefer those with a mechanical equity conversion feature since they are cheaper to use than those with a principal write-down feature and still satisfy the necessary condition for regulatory capital eligibility under Basel III (Avdjiev et al., 2013). This leads to the following fifth hypothesis:

*H5: A CoCo bond's mechanical equity conversion feature is negatively (positively) related to its buyer's (seller's) preferences.*

Providing CoCo bonds' credit ratings has been a challenge for the credit rating agencies for three main reasons. First, the different regulatory treatment of CoCo bonds across jurisdictions makes it difficult to have consistent rating methodologies. Second,

high-trigger CoCo bonds have the potential to cause more losses for CoCo bond holders ahead of the issuing bank's equity holders, which inverts the traditional hierarchy of investors and is an additional possibility the credit rating agencies need to consider. Third, the existence of the principal write-down feature (the discretionary trigger) creates valuation uncertainty, further complicating the rating process (Avdjiev et al., 2013).

For CoCo bonds not to convert, they should have high credit ratings which investors prefer to avoid internalizing possible losses from the issuing companies. On the other hand, banks prefer issuing CoCo bonds when they feel a strong need to increase their bankruptcy protection, especially when their credit ratings are low. Therefore, our sixth hypothesis is the following:

*H6: A CoCo bond's credit rating is positively (negatively) related to its buyer's (seller's) preferences.*

Therefore we control for the issuing bank's characteristics (size, price-to-book ratio, regulatory capital ratio ( $\frac{\text{total regulatory capital}}{\text{total risk weighted assets}}$ ) and leverage ( $\frac{\text{total debt}}{\text{total asset}}$ ) and underlying economic conditions (real GDP growth, inflation and unemployment rate).

#### 4. Methodology

We assume that CoCo bond buyers prefer a higher bid YTM (yield-to-maturity) but dislike risk, the CDS spread being the most appropriate risk measure for CoCo bonds according to the existing literature. We run a logistic regression, where the dependent variables (CoCo bond buyers' preference scores)  $P_{\text{SCORE}_{25}}$ ,  $P_{\text{SCORE}_{50}}$  and  $P_{\text{SCORE}_{75}}$  are defined as  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  which is compared to the corresponding 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentile values within each year, respectively, and take value one if greater than these percentiles and zero otherwise. The estimated regression is as follows.

$$P_{\text{buyer}} \left( \frac{y_{\text{CoCo Bond Bid YTM}}}{\text{CDS Spread}} \right) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 \times \text{CoCo\_Char} + \beta_2 \times \text{Firm\_Control} + \beta_3 \times \text{Economic\_Control})}} \quad (1)$$

Then we calculate the CoCo bond seller's preference score by subtracting the CoCo bond buyers' preference score from one. We assume that the CoCo bond buyers and sellers' preferences are mutually exclusive, namely:

$$\begin{aligned}
 & P_{\text{seller}} \left( \frac{y_{\text{CoCo Bond Bid YTM}}}{\text{CDS Spread}} \right) \\
 &= 1 - P_{\text{buyer}} \left( \frac{y_{\text{CoCo Bond Bid YTM}}}{\text{CDS Spread}} \right) \\
 &= \frac{1}{1 + e^{\beta_0 + \beta_1 \times \text{CoCo\_Char} + \beta_2 \times \text{Firm\_Control} + \beta_3 \times \text{Economic\_Control}}} \quad (2)
 \end{aligned}$$

The CoCo bond characteristics considered are coupon (%), maturity (this is a binary variable equal to one if permanent and zero otherwise), the amount issued (million US\$), the trigger level (%), conversion (this is a binary variable that equals one in the event of mechanical equity conversion and zero in the event of a permanent write-down, a partial permanent write-down and a temporary write-down) and credit rating (the average credit rating among Moody, S&P and Fitch ratings where each credit rating increment is 1, and the highest (Aaa, AAA) and lowest (Ca, CCC and below) credit ratings are 19 and 0 respectively). As for the CoCo bond issuing firm characteristics, these include return on common equity (ROE), firm size (the natural logarithm of the firm's total assets), price-to-book value ratio (P/B ratio), total regulatory capital to risk-weighted asset (TRC/RWA) and total debt to total asset (TD/TA). Finally, the economic control variables added to the regressions are real GPD (%), consumer price index (CPI) and unemployment rate (%).

We estimate preference scores for CoCo bonds taking into account country-specific market competitiveness using the Herfindahl index and the issuing or holding CoCo bond amount for each financial firm. We first compute the Herfindahl indices for CoCo bond buyers and sellers in each country assuming that the total number of firms within a country is  $N$  as shown in equations (3) and (4) below. High (low) values of (3) and (4) indicate high (low) concentration (degree of competition) of the CoCo bond market in country  $j$ .

$$S_{\text{country } j}^{\text{buyer}} = \sum_{i=1}^N \left( \frac{\text{holding Coco bond amount}_{\text{firm } i, \text{country } j}}{\text{holding Coco bond amount}_{\text{country } j}} \right)^2 \quad (3)$$

$$S_{\text{country } j}^{\text{seller}} = \sum_{i=1}^N \left( \frac{\text{issued Coco bond amount}_{\text{firm } i, \text{country } j}}{\text{issued Coco bond amount}_{\text{country } j}} \right)^2 \quad (4)$$

We assume that in a highly competitive CoCo bond market both buyers and sellers have stronger trading power. We use the total CoCo bond issue size for all  $N$  firms in country  $j$  as a measure for the CoCo bond market concentration (or degree of competition) in that country as in equation (3) and (4) above; the inverse of the Herfindahl index increases with the degree of competition of the CoCo bond market in country  $j$ . The preference scores are then rescaled using the CoCo bond market size of each country relative to the world's by dividing the CoCo bond stock issued by country  $j$  by that of the world,  $\frac{\text{Coco bond issued amount}_{\text{country } j}}{\text{Coco bond issued amount}_{\text{world}}}$ . The newly calculated Coco bond preference scores are therefore those specified in equation (5) and (6):

$$P_{\text{buyer, country } j}^{\text{preference score}} = P_{\text{buyer}}\left(\frac{y_{\text{CoCo Bond Bid YTM}}}{\text{CDS Spread}}\right) \times \underbrace{\frac{1}{s_{\text{country } j}^{\text{buyer}}} \times \frac{\text{Coco bond issued amount}_{\text{country } j}}{\text{Coco bond issued amount}_{\text{world}}}}_{\text{buyers' market power score for country } j} \quad (5)$$

$$P_{\text{seller, country } j}^{\text{preference score}} = P_{\text{seller}}\left(\frac{y_{\text{CoCo Bond Bid YTM}}}{\text{CDS Spread}}\right) \times \underbrace{\frac{1}{s_{\text{country } j}^{\text{seller}}} \times \frac{\text{Coco bond issued amount}_{\text{country } j}}{\text{Coco bond issued amount}_{\text{world}}}}_{\text{sellers' market power score for country } j} \quad (6)$$

It should be immediately apparent that a country's Coco bond preference scores are higher when its markets are highly competitive and its average trading volumes are higher than the world's.

## 5. Data and Empirical Results

### 5.1 Data Sources and Description

We collect CoCo bond data from Bloomberg between May 11, 2009 and March 19, 2018 using the SRCH@COCO command. We exclude the matured and cancelled ones, which yields an initial sample of 545 CoCo bonds from all over the world. Then we select those with the loss-absorbing property, which leaves 519 CoCo bonds from 29 countries including their corresponding issuing firm tickers. The CoCo bond's characteristics considered are: coupon (CPN in %), maturity (MAT: a binary variable showing one if permanent and zero otherwise), amount issued (AMT in million US \$), trigger level (TRI in %), conversion (CON: a binary variable that equals one in the event of mechanical equity conversion and zero in the event of principal write-down including permanent write-down, partial permanent write-down and temporary write-down) and credit rating (CRD: the average credit rating among Moody, S&P and Fitch ratings where each credit rating increment is 1, with 19 being the highest (Aaa, AAA) and 0 the lowest (Ca, CCC or below)).

As for the CoCo bond issuing firm characteristics and economic control variables, we also collect the data from Bloomberg and use the 6 months lagged ones vis-à-vis the CoCo bond data to avoid hindsight bias. The CoCo bond characteristics considered are: return on common equity (ROE), firm size (SIZE: the natural logarithm of the firm's total asset), price-to-book value ratio (P/B), total regulatory capital to risk-weighted asset (TRC/RWA) and total debt to total asset (TD/TA). The economic control variables used are real GDP growth (RGDP in yearly percentage change), the consumer price index (CPI in yearly percentage change) and the unemployment rate (UEM in %); the dependent variables (CoCo bond buyers' preference scores)  $P_{\text{SCORE\_25}}$ ,  $P_{\text{SCORE\_50}}$  and  $P_{\text{SCORE\_75}}$  are defined as  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  which is compared to the corresponding 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentile values, respectively, and take value one if greater than the median and zero otherwise. Table 1 shows summary statistics for the variables used for the analysis.

[Insert Table 1]

Most CoCo bonds have coupon rates between 6% and 7%, permanent maturities (about 81%), a trigger level around 5% and 6%, credit ratings between Ba2/BB/BB and Ba1/BB+/BB+ according to Moody/S&P/Fitch credit ratings, and 32% have the equity conversion property, while the remaining 68% have principal write-down features. Most of the variables in our sample do not exhibit a large difference between the mean and the median and have relatively non-skewed distributions, except for CPI and the preference scores of CoCo bond buyers and sellers. The mean of CPI (5.05) is much larger than its median (0.30), there is a clustering of low CPI values, and the distribution is right-skewed. On the other hand, the preference scores of buyers and sellers have mean values of 0.50 that are only half of their medians (1.00), exhibit clustering of high preference score values, and the distribution is left-skewed.

## 5.2 Empirical Results

Table 2 displays the results from the preference score logistic regression analysis.<sup>1</sup> We use three different binary dependent variables, SCORE\_25, SCORE\_50 and SCORE\_75 which are equal to one if the  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  is larger than the 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentile of

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<sup>1</sup> The variance inflation factor (VIF) test reported in Appendix I indicates that the logistic regressions are not affected by multi-collinearity.

all CoCo bond's  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  within the same year, respectively. The  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  is the return-to-risk ratio of a CoCo bond that the buyer can achieve. We expect the CoCo bond sellers' response to the regressors to be opposite to the buyers' one, which is confirmed by the opposite signs of the beta coefficients in equations (1) and (2), therefore we only report the first set of coefficients.

We find that buyers of CoCo bonds with low return-to-risk ratios (i.e., in the 25<sup>th</sup> percentile) are mostly interested in the issuing bank's financial conditions (P/B and TRC/RWA) and credit risk (CRD), i.e. the financial soundness of the CoCo bond issuing firms, especially if they are undervalued ( $P/B = -2.117$ ) and have enough regulatory capital ( $TRC/RWA = 0.523$ ) with a high credit rating ( $CRD = 0.896$ ), which is preferred by buyers because CoCo bonds force shareholders to internalize the negative consequences of a company's poor performance when they are converted (Flannery, 2015; Ammann et al., 2017). By contrast, sellers do not prefer a high credit rating because it might not be necessary to issue CoCo bonds if their financial condition is already stable enough. Sellers instead prefer to issue CoCo bonds only when the financial outlook is less promising and they are needed to satisfy the Basel III requirements. Thus, our results are consistent with H6. Overall, buyers seem to be more sensitive than sellers to the credit rating. Therefore, it may be worthwhile for the CoCo bond-issuing firms (the sellers) to consider increasing their CoCo credit rating since buyers may react more than sellers (Table 3). Overall, the CoCo bond buyers and sellers in the 25<sup>th</sup> percentile tend to exhibit risk-averse and risk-loving behavior, respectively, towards their CoCo bond investments.

The CoCo bond buyers investing in CoCo bonds with a medium return-to-risk ratio (i.e., in the 50<sup>th</sup> percentile), are more sensitive to CoCo bond (CPN, CON and CRD) and issuing bank's (TRC/RWA and TD/TA) characteristics than buyers in the lower (25<sup>th</sup>) or higher (75<sup>th</sup>) percentiles. They prefer high coupon payments ( $CPN = 1.17$ ), which is consistent with our hypothesis H1. Further, the impact of the coupon is stronger for buyers compared to sellers as implied by the absolute values of the respective coefficients (Table 3). This indicates that it is still worthwhile for sellers to consider increasing the coupon rates since CoCo bond buyers are more sensitive to an increase compared to sellers. The 50<sup>th</sup> percentile buyers also prefer to have CoCo bonds with a principal write-down feature ( $CON = -2.126$ ) since this imposes less restrictions to buy compared to the ones with mechanical equity conversions. However, sellers prefer to issue CoCo bonds with mechanical equity conversions since they are cheaper to issue than the ones with principal write-down

conversions but still satisfy the Basel III financial regulation requirements (Avdjiev et al., 2013, 2015). This supports hypothesis H5. These buyers still prefer a high credit rating of CoCo bonds ( $CRD = 1.592$ ) to avoid internalizing the negative financial consequences of the issuing bank with equity conversions in contrast to sellers who prefer to issue CoCo bonds with investors bearing the associated risk. They are interested in the financial soundness of the issuing banks and prefer them to have enough regulatory capital ( $TRC/RWA = 0.197$ ). Therefore, they tend to perceive a low regulatory capital ratio ( $TRC/RWA$ ) and credit rating ( $CRD$ ) as the main indicators of risk. At the same time, they are also interested in not having their ownership diluted if CoCo bonds have to be converted into equity in the worst-case scenario. Thus, they consider leverage ( $TD/TA$ ) to be most important in terms of how it affects their ownership as potential shareholders rather than as a risk measure since banks could have high leverage due to their business characteristics. However, we do not find a strong preference difference in terms of  $TD/TA$  between buyers and sellers as shown in Table 3 since buyers have to reduce the leverage risk in addition to remaining solvent.

Buyers holding CoCo bonds with a high return-to-risk level (in the 75<sup>th</sup> percentile) are more interested in the CoCo bond characteristics ( $CPN$ ,  $AMT$  and  $CRD$ ) and less in the issuing bank's financial soundness ( $TRC/RWA = 0.257$ ). Similarly to the 50<sup>th</sup> percentile buyers, they prefer a high coupon rate ( $CPN = 1.047$ ) and credit rating ( $CRD = 1.175$ ), which supports our hypotheses H1 and H6, respectively. Besides, these buyers prefer no additional CoCo bonds to be issued since their ownership gets diluted with an increased number of CoCo bond investors, who are potential shareholders when CoCo bonds are converted into common equity. In fact, we find a negative impact of the CoCo bond amount issued ( $AMT = -0.002$ ) on the buyers' preference score (Table 2). On the other hand, CoCo bond sellers prefer more CoCo bonds to be issued despite the high coupon rates, because these have a cost advantage over equity owing to their tax shield, can avoid debt overhang, reduce a bank's default probability, and represent a positive signal for equity holders according to the pecking order theory (Ammann et al., 2017). Therefore, we find that the effect of the issued amount on buyers and sellers' preferences is consistent with H3. Buyers still regard the regulatory capital amount ( $TRC/RWA = 0.257$ ) as the main requirement for CoCo bond issuing banks. They exhibit this type of behavior consistently across all three percentiles (25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup>) of buyers along with the credit rating criteria of CoCo bonds. Thus, these buyers and sellers are relatively more risk-loving and risk-averse, respectively. Other CoCo bond characteristics including maturity and trigger level have a weak or insignificant impact on the preference scores (Table 2) across percentiles.

Therefore, we find that both buyers and sellers prefer the CoCo bond issuing banks to be sound and creditworthy. Buyers prefer to have CoCo bonds with high coupon returns and principal write-down features (which are less restrictive than mechanical equity conversion), whilst the opposite holds for sellers who prefer to issue CoCo bonds paying lower coupons with mechanical equity conversion (which is cheaper than the principal write-down mechanism). In addition, buyers and sellers have a conflict of interests between ownership dilution and bankruptcy protection, respectively, which depends on the CoCo bond issued amount and existing total equity. They are most sensitive to CoCo bond and issuing bank's characteristics when they belong to the 50<sup>th</sup> percentile preference group. By contrast, the underlying economic conditions ( $\Delta$ RGDP, CPI and UEM) generally do not have a significant effect on their preference scores.

[Insert Table 2]

[Insert Table 3]

In Table 4, we analyze for each country the CoCo bond average preference responses to the increments of the significant factors (CPN, AMT, CRD, ROE, P/B and TRC/RWA) by considering country-specific CoCo bond market competitiveness using equations (5) and (6). We show this for buyers in the 25<sup>th</sup> (Panel A), 50<sup>th</sup> (Panel B) and 75<sup>th</sup> (Panel C) percentiles. Since the beta coefficients for buyers and sellers' preference scores are opposite (as in equation (1) and (2)), we only report the preference responses of buyers. We find that the most significantly factors are CPN, CON and CRD for CoCo bonds and P/B for the issuing banks across all three percentiles.

At the country level, buyers consistently prefer to enjoy the high coupon payments of CoCo bonds with a principal write-down mechanism which entails less restrictions as owners. On the other hand, since CoCo bond could be a costly security to issue, sellers prefer to pay lower coupon payments and use the mechanical equity conversion for CoCo bonds since it is cheaper than the principal write-down feature. The credit rating (CRD) can be subject to less valuation uncertainty depending on the regulatory treatment and rating methodologies (Avdjiev et al., 2013). Therefore, investors could react more to CRD than to the regulatory capital amount (TRC/RWA) or leverage (TD/TA) which follow more globally consistent measures such as Basel, accounting standards, etc. Furthermore, both buyers and sellers could perceive CoCo bonds as being close to equity since their high coupon rates



make them costly to issue, the equity conversion mechanism involves additional costs and the owners become shareholders when CoCo bonds are converted into equity. Accordingly, they could be quite sensitive to the over- or under-valuation (P/B) of the issuing bank similarly to the case of stock investment decisions. Therefore, buyers and sellers appear to be highly responsive to the issuing bank's P/B ratio.

Geographically, we find that in most European countries (e.g., France, Ireland, Italy, Netherlands, Spain, Sweden, Switzerland and UK), Brazil, Mexico and China there are significant reactions to the CoCo bond and issuing bank's factors. In particular, the UK and China are the two countries with the strongest responses from both buyers and sellers (see Table 4 and Appendix II).

[Insert Table 4]

## 6. Conclusions

This paper estimates the preference scores of CoCo bond buyers and sellers by running logistic regressions taking into account both bond and issuing bank's characteristics, unlike the few existing CoCo bond event studies that only focus on general equity holders. It also provides evidence on the role of country-specific CoCo bond market concentration.

More specifically, we use CoCo bond data between May 11, 2009 and March 19, 2018 excluding the matured and cancelled ones. We estimate logistic regressions to obtain the preference scores expressed in probabilities, and define buyers as having a preference for CoCo bonds if their return-to-risk ( $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$ ) is higher than the corresponding 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> annual percentile values; this variable takes value one if it is greater than these percentiles and zero otherwise; we assume that the preferences of buyers and sellers are mutually exclusive.

We find that the buyers and sellers in the 25<sup>th</sup> percentile are risk-averse and risk-loving respectively. Buyers are more interested in the issuing bank's financial conditions and credit risk whereas sellers prefer to issue CoCo bonds only when they expect a less promising financial outlook and have to satisfy the Basel III financial regulations. The buyers and sellers in the 50<sup>th</sup> percentile are interested not only in the issuing bank's financial outlook or conditions but also in the CoCo bond's coupon payments and equity conversion mechanism. These buyers prefer CoCo bonds with high coupon payments and (less restrictive) principal write-down features. On the contrary, sellers prefer low coupon payments and mechanical equity conversion features since these are cheaper. Finally, the buyers and sellers in the 75<sup>th</sup>

percentile exhibit risk-loving and risk-averse behaviour, respectively, in contrast to those in the 25<sup>th</sup> percentile. While they behave similarly to those in the 50<sup>th</sup> percentile, they are also sensitive to the total CoCo bond amount issued. These buyers prefer banks to issue fewer CoCo bonds in order not to have their ownership diluted too much once these are converted into equity. By contrast, sellers prefer issuing more CoCo bonds as this results in more effective bankruptcy protection and compliance with the Basel III regulations.

We also consider the country-specific CoCo bond market concentration (by calculating Herfindahl indices for each country using the CoCo bond issue size for each bank) assuming that higher market competition gives more trading power to both buyers and sellers. We find that coupon payment, conversion mechanism, credit rating and P/B ratio are the strongest global determinants of CoCo bond trading between buyers and sellers. Buyers and sellers are very responsive to CoCo bond and issuing bank's characteristics in most European countries, Brazil, Mexico and China (especially in the UK and China). These findings are relevant to both regulators and investors interested in understanding the conflicting preferences of CoCo bond buyers and sellers, their determinants, and their geographical features.

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**Table 1. Summary statistics**

The following table shows the summary statistics for the CoCo bonds in the sample (between May 11, 2009 and March 19, 2018 excluding the matured and cancelled ones), their issuing firms and the underlying economic characteristics. The CoCo bond characteristics considered are: coupon (CPN in %), maturity (MAT), amount issued (AMT in million US \$), trigger level (TRI in %), conversion (CON) and credit rating (CRD). The CoCo bond issuing firm characteristics included are: return on common equity (ROE), firm size (SIZE), price-to-book value ratio (P/B), total regulatory capital to risk-weighted asset (TRC/RWA) and total debt to total asset (TD/TA). The economic control variables are real GDP growth (RGDP in yearly percentage change), consumer price index (CPI in yearly percentage change) and unemployment rate (UEM in %). For our dependent variables, we use  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  for CoCo bond investors preference scores; these are equal to one if greater or equal to the 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentiles of the overall CoCo bonds and zero otherwise which are SCORE\_25, SCORE\_50 and SCORE 75, respectively. We report the mean, median, standard deviation (Std.), 75<sup>th</sup> percentile, 25<sup>th</sup> percentile and total number of observations (*N*).

|   | Mean   | Median | Std.    | 75 <sup>th</sup><br>Percentile | 25 <sup>th</sup><br>Percentile | <i>N</i> |
|---|--------|--------|---------|--------------------------------|--------------------------------|----------|
| Coupon (CPN)                                    | 6.61   | 6.25   | 2.36    | 8.00                           | 5.00                           | 517      |
| Maturity (MAT)                                  | 0.81   | 1.00   | 0.40    | 1.00                           | 1.00                           | 519      |
| Amount issued (AMT)                             | 827.82 | 500.00 | 1047.53 | 1250.00                        | 80.39                          | 519      |
| Trigger level (TRI)                             | 5.41   | 5.13   | 1.15    | 5.50                           | 5.13                           | 519      |
| Credit rating (CRD)                             | 8.48   | 9.00   | 2.22    | 10.00                          | 7.50                           | 293      |
| Conversion (CON)                                | 0.32   | 0.00   | 0.47    | 1.00                           | 0.00                           | 519      |
| ROE   | 7.25   | 7.12   | 7.11    | 10.89                          | 3.17                           | 300      |
| Firm size (SIZE)                                | 12.43  | 12.99  | 2.15    | 13.94                          | 11.34                          | 357      |
| P/B ratio (P/B)                                 | 1.03   | 0.86   | 0.64    | 1.22                           | 0.72                           | 287      |
| TRC/RWA   | 16.03  | 15.63  | 3.63    | 18.20                          | 13.35                          | 334      |
| TD/TA   | 30.62  | 30.51  | 16.17   | 37.16                          | 18.31                          | 357      |
| Real GDP growth ( $\Delta$ RGDP)                | 1.88   | 1.90   | 3.36    | 3.00                           | 0.90                           | 519      |
| CPI   | 5.05   | 0.30   | 23.05   | 0.70                           | 0.00                           | 515      |
| Unemployment rate (UEM)                         | 6.99   | 6.30   | 4.00    | 8.00                           | 4.20                           | 519      |
| Bid Yield (Bid_YTM)                             | 6.99   | 6.70   | 2.35    | 8.36                           | 5.60                           | 314      |
| CDS spread (CDS)                                | 137.96 | 117.00 | 111.35  | 201.00                         | 65.00                          | 483      |
| 25 <sup>th</sup> preference score<br>(SCORE_25) | 0.75   | 1.00   | 0.43    | 1.00                           | 0.50                           | 271      |



|   |      |      |      |      |      |     |
|---|------|------|------|------|------|-----|
| 50 <sup>th</sup> preference score<br>(SCORE_50) | 0.51 | 1.00 | 0.50 | 1.00 | 0.00 | 271 |
| 75 <sup>th</sup> preference score<br>(SCORE_75) | 0.26 | 0.00 | 0.44 | 1.00 | 0.00 | 271 |

**Table 2. CoCo bond buyer and seller's preference score logistic regression analysis**

The following table presents the logistic regression analyses with CoCo bond buyer and seller's preference scores as dependent variables and CoCo bond (between May 11, 2009 and March 19, 2018 excluding the matured and cancelled ones), its issuing bank and economic characteristics as independent variables. The CoCo bond characteristics we consider are coupon (CPN in %), maturity (MAT), amount issued (AMT in million US \$), trigger level (TRI in %), conversion (CON) and credit rating (CRD). The CoCo bond-issuing firm characteristics included are return on common equity (ROE), firm size (SIZE), price-to-book value ratio (P/B), total regulatory capital to risk-weighted asset (TRC/RWA) and total debt to total asset (TD/TA). The economic control variables are real GDP growth (RGDP in yearly percentage change), consumer price index (CPI in yearly percentage change) and unemployment rate (UEM in %). For our dependent variables, we use  $\frac{\text{CoCo Bond Bid YTM}}{\text{CDS Spread}}$  for CoCo bond investors preference scores; these are equal to one if greater or equal to the 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentiles of the overall CoCo bonds and zero otherwise which are SCORE\_25, SCORE\_50 and SCORE 75, respectively. We report  $\chi^2$  and  $R^2$  as our goodness-of-fit measures and  $N$  as the total number of observations. \* stands for significance at the 10% level, \*\* at the 5% level and \*\*\* represents at the 1% level.

|                                 |               | SCORE_25                    | SCORE_50                    | SCORE_75                     |
|---------------------------------|---------------|-----------------------------|-----------------------------|------------------------------|
|                                 | (Intercept)   | <b>-13.39*</b><br>(-1.788)  | -43.76<br>(-0.031)          | -30.27<br>(-0.014)           |
| CoCo bond<br>characteristics    | CPN           | <b>0.687*</b><br>(1.947)    | <b>1.17***</b><br>(3.378)   | <b>1.047**</b><br>(2.46)     |
|                                 | MAT           | <b>3.01*</b><br>(1.736)     | 24.31<br>(0.017)            | 24<br>(0.011)                |
|                                 | AMT           | -0.0004<br>(-0.524)         | 0.001<br>(1.593)            | <b>-0.002***</b><br>(-2.668) |
|                                 | TRI           | -0.557<br>(-1.224)          | -0.144<br>(-0.333)          | -0.855<br>(-1.545)           |
|                                 | CON           | 0.046<br>(0.054)            | <b>-2.126**</b><br>(-2.561) | -0.409<br>(-0.386)           |
|                                 | CRD           | <b>0.896***</b><br>(2.835)  | <b>1.592***</b><br>(3.953)  | <b>1.175**</b><br>(2.509)    |
| Issuing bank<br>characteristics | ROE           | -0.026<br>(-0.525)          | -0.026<br>(-0.467)          | 0.054<br>(0.545)             |
|                                 | SIZE          | -0.258<br>(-0.735)          | -0.297<br>(-0.925)          | -0.283<br>(-0.57)            |
|                                 | P/B           | <b>-2.117**</b><br>(-2.488) | -1.309<br>(-1.583)          | <b>-3.609*</b><br>(-1.888)   |
|                                 | TRC/RWA       | <b>0.523***</b><br>(3.016)  | <b>0.197**</b><br>(2.254)   | <b>0.257**</b><br>(1.993)    |
|                                 | TD/TA         | 0.005<br>(0.143)            | <b>0.07**</b><br>(2.32)     | -0.015<br>(-0.494)           |
| Economic<br>characteristics     | $\Delta$ RGDP | 0.126<br>(0.553)            | 0.113<br>(0.383)            | -0.147<br>(-0.322)           |
|                                 | CPI           | 0.156<br>(0.583)            | 0.011<br>(0.693)            | -0.014<br>(-0.121)           |
|                                 | UEM           | 0.01<br>(0.13)              | <b>-0.161*</b><br>(-1.719)  | -0.112<br>(-0.789)           |
| Year Fixed Effect               |               | Yes                         | Yes                         | Yes                          |
| $\chi^2$                        |               | <b>44.16***</b>             | <b>81.34***</b>             | <b>48.85***</b>              |
| $R^2$                           |               | 0.34                        | 0.44                        | 0.41                         |
| $N$                             |               | 132                         | 132                         | 132                          |

**Table 3. Relative impact of significant factors on the CoCo bond buyer and seller's preference scores**

The following table shows the relative impact of the significant factors from Table 2's SCORE\_50 on the CoCo bond buyer and seller's preference scores. These factors include coupon (CPN), conversion (CON), credit rating (CRD), total regulatory capital to risk-weighted asset (TRC/RWA) and total debt to total asset (TD/TA). The buyer's preference score (in the second column) is calculated from the incremental effect of each factor in equation (1). The seller's preference score (in the third column) are calculated by subtracting the buyer's preference score from one under the assumption that the preference scores between buyers and sellers are mutually exclusive. The stronger impact (in the fourth column) is selecting the larger preference score between the buyer and seller for each factor.

| Factors | Buyer  | Seller | Stronger impact |
|---------|--------|--------|-----------------|
| CPN     | 76.31% | 23.69% | Buyers          |
| CON     | 10.66% | 89.34% | Sellers         |
| CRD     | 83.09% | 16.91% | Buyers          |
| TRC/RWA | 54.90% | 45.10% | Buyers          |
| TD/TA   | 51.76% | 48.24% | Buyers          |

**Table 4. Global CoCo bond buyers and sellers' preference scores with incremental factor change**

The following tables present the incremental change in CoCo bond's global preference scores based on the 25<sup>th</sup>, 50<sup>th</sup> and 75<sup>th</sup> percentile benchmarks in Panel A ( $\Delta$ SCORE\_25), B ( $\Delta$ SCORE\_50) and C ( $\Delta$ SCORE\_75), respectively. We provide the global preference scores with the incremental changes in significant factors in Table 2. The preference scores are scaled by the market power score for each country to provide country specific preference scores as in our equation (5) and (6). We report the country and factor average preference responses which are the average values across each row and column, respectively.

| <b>Panel A. <math>\Delta</math>SCORE_25</b>                              |            |            |                     |                            |
|--|------------|------------|---------------------|----------------------------|
| <b>(Preference response of the 25<sup>th</sup> percentile investors)</b> |            |            |                     |                            |
| <b>Country</b>   | <b>CRD</b> | <b>P/B</b> | <b>TRC/<br/>RWA</b> | <b>Country<br/>average</b> |
| Australia  | 6.97%      | -16.48%    | 4.07%               | -1.81%                     |
| Austria  | 2.94%      | -6.95%     | 1.72%               | -0.76%                     |
| Belgium  | 2.55%      | -6.04%     | 1.49%               | -0.66%                     |
| Brazil   | 70.23%     | -165.99%   | 40.98%              | -18.26%                    |
| China  | 652.68%    | -1542.61%  | 380.81%             | -169.71%                   |
| Colombia   | 0.20%      | -0.47%     | 0.12%               | -0.05%                     |
| Cyprus   | 0.18%      | -0.43%     | 0.11%               | -0.05%                     |
| Czech  | 0.05%      | -0.11%     | 0.03%               | -0.01%                     |
| Denmark  | 11.00%     | -25.99%    | 6.42%               | -2.86%                     |
| Estonia  | 0.00%      | 0.00%      | 0.00%               | 0.00%                      |
| Finland  | 0.12%      | -0.29%     | 0.07%               | -0.03%                     |
| France   | 268.97%    | -635.72%   | 156.93%             | -69.94%                    |
| Germany  | 12.35%     | -29.18%    | 7.20%               | -3.21%                     |
| India  | 10.76%     | -25.44%    | 6.28%               | -2.80%                     |
| Indonesia  | 0.00%      | 0.00%      | 0.00%               | 0.00%                      |
| Ireland  | 52.99%     | -125.25%   | 30.92%              | -13.78%                    |
| Israel   | 1.37%      | -3.23%     | 0.80%               | -0.36%                     |
| Italy  | 53.67%     | -126.84%   | 31.31%              | -13.95%                    |
| Luxembourg   | 17.23%     | -40.72%    | 10.05%              | -4.48%                     |
| Malaysia   | 2.37%      | -5.60%     | 1.38%               | -0.62%                     |

|                           |          |           |         |          |
|---------------------------|----------|-----------|---------|----------|
| Mexico                    | 21.46%   | -50.71%   | 12.52%  | -5.58%   |
| Netherlands               | 38.31%   | -90.54%   | 22.35%  | -9.96%   |
| New Zealand               | 0.03%    | -0.07%    | 0.02%   | -0.01%   |
| Norway                    | 6.13%    | -14.48%   | 3.57%   | -1.59%   |
| Portugal                  | 0.14%    | -0.34%    | 0.08%   | -0.04%   |
| Spain                     | 90.31%   | -213.45%  | 52.69%  | -23.48%  |
| Sweden                    | 31.50%   | -74.46%   | 18.38%  | -8.19%   |
| Switzerland               | 289.92%  | -685.24%  | 169.16% | -75.39%  |
| United Kingdom            | 1347.93% | -3185.84% | 786.45% | -350.49% |
| <b>Factor<br/>average</b> | 103.18%  | -243.88%  | 60.20%  |          |

| Panel B. $\Delta$ SCORE_50<br>(Preference response of the 50 <sup>th</sup> percentile investors) |         |           |          |             |        |                    |
|--|---------|-----------|----------|-------------|--------|--------------------|
| Country  | CPN     | CON       | CRD      | TRC/<br>RWA | TD/TA  | Country<br>average |
| Australia  | 9.11%   | -16.55%   | 12.39%   | 1.53%       | 0.55%  | 1.41%              |
| Austria  | 3.84%   | -6.98%    | 5.23%    | 0.65%       | 0.23%  | 0.59%              |
| Belgium  | 3.34%   | -6.06%    | 4.54%    | 0.56%       | 0.20%  | 0.52%              |
| Brazil   | 91.74%  | -166.70%  | 124.83%  | 15.42%      | 5.51%  | 14.16%             |
| China  | 852.55% | -1549.16% | 1160.05% | 143.33%     | 51.17% | 131.59%            |
| Colombia   | 0.26%   | -0.47%    | 0.35%    | 0.04%       | 0.02%  | 0.04%              |
| Cyprus   | 0.24%   | -0.44%    | 0.33%    | 0.04%       | 0.01%  | 0.04%              |
| Czech  | 0.06%   | -0.11%    | 0.08%    | 0.01%       | 0.00%  | 0.01%              |
| Denmark  | 14.37%  | -26.10%   | 19.55%   | 2.42%       | 0.86%  | 2.22%              |
| Estonia  | 0.00%   | 0.00%     | 0.00%    | 0.00%       | 0.00%  | 0.00%              |
| Finland  | 0.16%   | -0.29%    | 0.22%    | 0.03%       | 0.01%  | 0.02%              |
| France   | 351.34% | -638.42%  | 478.06%  | 59.07%      | 21.09% | 54.23%             |
| Germany  | 16.13%  | -29.31%   | 21.95%   | 2.71%       | 0.97%  | 2.49%              |
| India  | 14.06%  | -25.54%   | 19.13%   | 2.36%       | 0.84%  | 2.17%              |
| Indonesia  | 0.00%   | 0.00%     | 0.00%    | 0.00%       | 0.00%  | 0.00%              |
| Ireland  | 69.22%  | -125.78%  | 94.19%   | 11.64%      | 4.16%  | 10.68%             |
| Israel   | 1.79%   | -3.25%    | 2.43%    | 0.30%       | 0.11%  | 0.28%              |
| Italy  | 70.10%  | -127.38%  | 95.39%   | 11.79%      | 4.21%  | 10.82%             |
| Luxembourg   | 22.51%  | -40.90%   | 30.63%   | 3.78%       | 1.35%  | 3.47%              |
| Malaysia   | 3.10%   | -5.62%    | 4.21%    | 0.52%       | 0.19%  | 0.48%              |
| Mexico   | 28.03%  | -50.93%   | 38.13%   | 4.71%       | 1.68%  | 4.33%              |
| Netherlands  | 50.04%  | -90.92%   | 68.09%   | 8.41%       | 3.00%  | 7.72%              |
| New Zealand  | 0.04%   | -0.07%    | 0.05%    | 0.01%       | 0.00%  | 0.01%              |
| Norway   | 8.00%   | -14.54%   | 10.89%   | 1.35%       | 0.48%  | 1.24%              |
| Portugal   | 0.19%   | -0.34%    | 0.25%    | 0.03%       | 0.01%  | 0.03%              |
| Spain  | 117.97% | -214.36%  | 160.51%  | 19.83%      | 7.08%  | 18.21%             |

|                       |          |           |          |         |         |         |
|-----------------------|----------|-----------|----------|---------|---------|---------|
| Sweden                | 41.15%   | -74.78%   | 56.00%   | 6.92%   | 2.47%   | 6.35%   |
| Switzerland           | 378.71%  | -688.15%  | 515.31%  | 63.67%  | 22.73%  | 58.45%  |
| United Kingdom        | 1760.72% | -3199.39% | 2395.78% | 296.01% | 105.69% | 271.76% |
| <b>Factor average</b> | 134.78%  | -244.92%  | 183.40%  | 22.66%  | 8.09%   |         |



| Panel C. $\Delta$ SCORE_75<br>(Preference response of the 75 <sup>th</sup> percentile investors) |         |        |         |             |                    |
|--|---------|--------|---------|-------------|--------------------|
| Country  | CPN     | AMT    | CRD     | TRC/<br>RWA | Country<br>average |
| Australia  | 8.15%   | -0.02% | 9.15%   | 2.00%       | 4.82%              |
| Austria  | 3.44%   | -0.01% | 3.86%   | 0.84%       | 2.03%              |
| Belgium  | 2.99%   | -0.01% | 3.35%   | 0.73%       | 1.77%              |
| Brazil   | 82.09%  | -0.17% | 92.13%  | 20.13%      | 48.55%             |
| China  | 762.92% | -1.53% | 856.19% | 187.05%     | 451.16%            |
| Colombia   | 0.23%   | 0.00%  | 0.26%   | 0.06%       | 0.14%              |
| Cyprus   | 0.21%   | 0.00%  | 0.24%   | 0.05%       | 0.13%              |
| Czech  | 0.05%   | 0.00%  | 0.06%   | 0.01%       | 0.03%              |
| Denmark  | 12.86%  | -0.03% | 14.43%  | 3.15%       | 7.60%              |
| Estonia  | 0.00%   | 0.00%  | 0.00%   | 0.00%       | 0.00%              |
| Finland  | 0.14%   | 0.00%  | 0.16%   | 0.04%       | 0.08%              |
| France   | 314.41% | -0.63% | 352.84% | 77.08%      | 185.93%            |
| Germany  | 14.43%  | -0.03% | 16.20%  | 3.54%       | 8.54%              |
| India  | 12.58%  | -0.03% | 14.12%  | 3.08%       | 7.44%              |
| Indonesia  | 0.00%   | 0.00%  | 0.00%   | 0.00%       | 0.00%              |
| Ireland  | 61.94%  | -0.12% | 69.52%  | 15.19%      | 36.63%             |
| Israel   | 1.60%   | 0.00%  | 1.79%   | 0.39%       | 0.95%              |
| Italy  | 62.73%  | -0.13% | 70.40%  | 15.38%      | 37.10%             |
| Luxembourg   | 20.14%  | -0.04% | 22.60%  | 4.94%       | 11.91%             |
| Malaysia   | 2.77%   | -0.01% | 3.11%   | 0.68%       | 1.64%              |
| Mexico   | 25.08%  | -0.05% | 28.15%  | 6.15%       | 14.83%             |
| Netherlands  | 44.78%  | -0.09% | 50.25%  | 10.98%      | 26.48%             |
| New Zealand  | 0.03%   | 0.00%  | 0.04%   | 0.01%       | 0.02%              |
| Norway   | 7.16%   | -0.01% | 8.04%   | 1.76%       | 4.23%              |
| Portugal   | 0.17%   | 0.00%  | 0.19%   | 0.04%       | 0.10%              |
| Spain  | 105.56% | -0.21% | 118.47% | 25.88%      | 62.43%             |

|                           |          |        |          |         |         |
|---------------------------|----------|--------|----------|---------|---------|
| Sweden                    | 36.83%   | -0.07% | 41.33%   | 9.03%   | 21.78%  |
| Switzerland               | 338.90%  | -0.68% | 380.33%  | 83.09%  | 200.41% |
| United Kingdom            | 1575.62% | -3.17% | 1768.24% | 386.30% | 931.75% |
| <b>Factor<br/>average</b> | 68.65%   | -0.14% | 77.04%   | 16.83%  |         |

### Appendix I. Variance inflation factor (VIF) test

This table presents the Variance inflation factor (VIF) test results for the independent variables used in the regressions in Table 2 to identify multicollinearity problem. As a rule of thumb, the VIF values below at least 10 or 5 are assumed to be safe from problems of multicollinearity.

| Variables     | SCORE_25 | SCORE_50 | SCORE_75 |
|---------------|----------|----------|----------|
| CPN           | 1.82     | 1.78     | 1.67     |
| MAT           | 1.46     | 1.00     | 1.00     |
| AMT           | 1.50     | 1.57     | 1.38     |
| TRI           | 1.57     | 1.63     | 1.51     |
| CRD           | 1.70     | 2.16     | 1.99     |
| CON           | 1.52     | 1.68     | 1.58     |
| ROE           | 1.36     | 1.55     | 1.76     |
| SIZE          | 1.37     | 1.31     | 1.40     |
| P/B           | 1.41     | 1.55     | 2.39     |
| TRC/RWA       | 1.49     | 1.19     | 1.70     |
| TD/TA         | 1.30     | 1.36     | 1.41     |
| $\Delta$ RGDP | 1.38     | 1.51     | 1.79     |
| CPI           | 1.34     | 1.18     | 1.04     |
| UEM           | 1.65     | 1.65     | 1.75     |

## Appendix II

### Country average response of the CoCo bond's preference score: $\Delta\text{SCORE}_{50}$

The following figure shows the country average preference responses for CoCo bond buyers  $\Delta\text{SCORE}_{50}$  in Table 3 Panel B. We show the  $\Delta\text{SCORE}_{50}$  as a representative one it has the most factors responsive compared to  $\Delta\text{SCORE}_{25}$  and  $\Delta\text{SCORE}_{75}$  while the overall map results are highly similar. The CoCo bond seller's country average preference response shows the same figure as below since it is only the opposite response while we capture only their absolute values. The darker blue shade indicates larger absolute values of the country average preference response.

